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Dendrimers and Small-angle Neutron Scattering: History and Perspectives

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Dendrimers are synthetic macromolecules having a defined architecture. Starting from a trifunctional monomer (generation 0), subsequent generations are connected to this initial core from which in a treelike structure results. Small-angle neutron scattering (SANS) has been extremely useful for the characterization of these molecules since it allows us to change the contrast through mixtures of deuterated and protonated solvents. In this way, SANS served for a full characterization of dendrimers set up of flexible [1] or stiff molecular units.[2, 3] Moreover, a SANS-study of flexible dendrimers with partially deuteration of the endgroups led to the unambiguous conclusion that these dendrimers have a dense core, that is, the endgroups fold back to a certain extend.[4] Another feature revealed by SANS in conjunction with modeling by molecular dynamics is the soft interaction of flexible dendrimers in solution.[5-7]
In this lecture we will review this work and its extension to more recent systems including DNA-based, charged dendrimers. We will demonstrate that, in the latter case, the generation number, the salt concentration and the flexibility between different generations serve as physical control parameters to tune the softness of the dendrimer interactions.[8] Finally, we will show how a combined effort between synthesis, theory and SAXS-measurements reveals that suitably engineered, hybrid dendrimers have recently led to the experimental verification of cluster crystals,[9] a novel state of matter, 20 years after its original theoretical prediction.[10]

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